

Libby Asbestos Site
Operable Unit 3
Biological Technical Assistance Group
Meeting
February 28, 2008

Meeting Summary

Agenda
And
Meeting Participants

Libby Asbestos Site
Operable Unit 3
Biological Technical Assistance Group (BTAG) Meeting
February 28, 2008

Proposed Agenda

Welcome and Introduction	9:00am - 9:15am
Review of Asbestos Profile (Appendix _ of Problem Formulation)	9:15am – 9:45am
Discussion of Phase I Remedial Investigation Results	9:45am – 10:30am

Short Break

Discussion of Ecological Risk Assessment Strategy	10:45am – 12:15pm
<ul style="list-style-type: none">Assessing Risks to Aquatic ReceptorsAssessing Risks to Mammalian Receptors	

Lunch

Discussion of Ecological Risk Assessment Strategy (cont.)	1:00pm – 3:00pm
<ul style="list-style-type: none">Assessing Risks to Avian ReceptorsAssessing Risks to Terrestrial Plants and Soil InvertebratesAssessing Risks to Amphibians	

Short Break

Discussion of Implementation	3:15pm – 4:15pm
<ul style="list-style-type: none">Sampling PlansScheduleRisk Management Decision Points	
Summary of BTAG Comments at Today's Meeting	4:15pm – 5:00pm



By _____ Date 2-28-08 Client _____ Sheet _____ of _____
Chkd. By _____ Description BIAG MEETING - LIBBY ASBESTOS Job No. _____

OU3

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Meeting Summary

**Libby Operable Unit 3 (OU3) Biological Technical Assistance Group
February 28, 2008 Meeting**

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• Schedule	
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Review of Asbestos Profile, Attachment D of Draft Problem Formulation Document

- Question on the fate and transport discussion: Is there any information available on the transport of asbestos into soil via surface water runoff from asbestos contaminated areas? Response: One objective of the remedial investigation is to collect data on asbestos levels in surface water to characterize transport of asbestos via surface water runoff from soil and mine waste contaminated with LA.
- One of the slides indicates that weathering of natural deposits may not be an important release mechanism at the Libby OU3 site. This wasn't the intended message. Slide will be corrected.
- There was consensus that a list of the literature reviewed by EPA in developing the draft "Problem Formulation for Ecological Risk Assessment at Operable Unit 3, Libby Asbestos Site" should be made available to the BTAG and other interested parties. EPA will have the list posted on the OU3 web page (<http://www.newfields.com/dl/libby/> user name: libby, password: newfields). Other BTAG participants may notify EPA of other literature that should be reviewed at any time. They will be added to the list.
- Question about the significance of inhalation exposure to ecological receptors: Why is inhalation likely to be important for ecological receptors? How does evaluation of inhalation relate to the assessment endpoints that are directly related to population stability identified in the problem formulation, i.e., mortality, growth, and reproduction? Response: Inhalation of LA may result in reduced growth, reproduction or survival which are related to population stability. Inhalation exposures may also cause a loss of respiratory fitness which may be related to effects on growth, and/or reduced life span due to cancer effects.
- The BTAG acknowledges exposure to asbestos by ecological receptors within Libby OU3. The extent of exposure is unknown and whether there are significant adverse effects as a result of exposure is also unknown. Some BTAG participants are concerned that following exposure, there may be a significant latency period before effects occur. This should be taken into account in determining the significance of exposure pathways and the effects that will be studied in the ecological risk assessment for OU3.
- Discussion of conceptual site model (CSM): Since it's unknown whether exposure to asbestos by ecological receptors presents significant risk of adverse effects, the BTAG suggested that exposure pathways should be characterized as either complete or incomplete on the CSM. The CSM should not attempt to judge whether complete pathways are significant at this point. The ecological risk assessment will provide information to evaluate the significance of the

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exposure. The BTAG recommended that EPA reconsider the open and closed circles in the current version of the CSM.

Discussion of Phase I Remedial Investigation Results

- Some BTAG participants recommended that the figures use a different color scheme when presenting Phase I results. The use of red dots to indicate certain concentration levels gives the impression that these levels are unacceptable or are above a level of concern and at this point, we don't know that.
- The PLM-VE analytical method requires a specific sample preparation procedure involving drying, sieving into a coarse and fine fraction, and then grinding the fine fraction. The PLM-VE results are reported as a mass percent, i.e., the mass of LA as a percent of the total sample mass. This should not be considered as the amount of LA that is available for exposure in the environment. The BTAG participants expressed concern that the PLM-VE results could be misinterpreted this way. EPA will be careful in its communication of the PLM-VE results to avoid this potential confusion.
- EPA clarified that collection of forest soil samples and mine waste samples as described in Phase I will not be repeated in Phase II.
- Some BTAG participants questioned whether there is a need to collect two additional rounds of sediment samples (repeating the Phase I sampling plan). Do we expect to see the sediment results change significantly? The response was that the additional number of samples is needed to increase the confidence in the comparison of sediment results to benchmarks in the non-asbestos screening – level ecological risk assessment and to increase the confidence in the calculation of exposure point concentrations in the ecological risk assessment for asbestos.

Discussion of Ecological Risk Assessment Strategy

Assessing Risks to Aquatic Receptors

- Some BTAG participants suggested that EPA consider using the sampling location "URC-1" as a reference location for lower Rainy Creek.
- Data on the streams within OU3 is available from the Forest Service. They have done various analyses of streams and the data is available in their offices. The BTAG considered various options for obtaining this data including visiting the Forest Service offices in Montana and spending some time reviewing files and making copies of pertinent information. There were also some concerns that this level of effort could be high and may not be of much use [the past data, if found, would not alter the planned sampling activities to assess current conditions].

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- BTAG participants noted that toxicity test results are often difficult to interpret.
- The slides indicate decision points based on “risk “or “no risk”. These should be changed to “acceptable risk” or “unacceptable” risk.
- BTAG participants recommended doing the histopathological examinations on fish collected during the population surveys.
- EPA offered to provide examples of ecological risk assessments performed in Region 8 that use the weight of evidence approach that Region 8 will use at Libby OU3.
- BTAG members discussed the pros and cons of collecting numerous spring run-off samples for toxicity testing vs. collecting site water from a single station to be supplemented with spiking of LA vs. spiking laboratory water with LA. Concerns raised included logistical considerations of shipping large quantities of water, acquiring appropriate spiking material and the underlying assumption in the problem formulation that the highest concentrations of LA will be observed at high flow. The draft Phase IIA Sampling and Analysis Plan (SAP) contains the scope of the required toxicity testing. That SAP is currently under review. EPA will consider review comments in developing the final SAP.

Assessing Risks to Mammalian Receptors

- Question: If no LA is detected in ambient air samples from OU3, is this evidence that inhalation exposures are not likely to be significant? Response: While the ambient air data will be considered, inhalation exposures are dependent on the activity of the receptor. Activities may result in re-suspension of LA into air from a localized area and ecological receptors may be exposed via the inhalation pathway as a result of this localized re-suspension.
- Slides indicate a decision point (illustrated by a red dot). This is the point where uncertainties in the weight of evidence evaluation may lead to more focused studies in order to reduce uncertainties and help determine the likelihood of population level effects on growth, mortality or reproduction. This decision point is not meant to represent that EPA will attempt to avoid necessary studies. Possible studies are illustrated in white on the slides.
- There was some discussion as to the best time of year to collect small mammals. The decision was reached that the fall was the best time of year.
- Question: Could the assessment focus on sampling small mammal populations first and then if effects are observed then proceed to histopathology? Response: Given the uncertainties in population level measurements (number of mammals and number of species, etc) and the variability across years, it is necessary to use

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this measurement endpoint along with others (histopathology and tissue burdens) as part of a weight-of-evidence.

- Some BTAG participants suggested that EPA consider the cost-effectiveness of sampling to determine the level of LA in food sources and forage items rather than ecological receptors. This may be easier to implement since food sources would not require setting traps and collecting wildlife (and birds). The results could be used to determine the relative contribution of the ingestion exposure pathway to inhalation of re-suspended LA in air. Relative significance of the exposures (risks), however, would not be possible to interpret due to a lack of ingestion and inhalation toxicity data specific to LA

Assessing Risks to Avian Receptors

- Although results are only available from monitoring performed in October 2007, the available data seem to suggest that exposure via inhalation of ambient air may not be of concern. However, as discussed earlier, exposures are also associated with the disturbance and suspension of LA in air during activities. Additionally, it is unknown at this point whether existing ambient air results are representative of site conditions due to the occurrence of rain during the October 2007 sampling event.
- The BTAG would like to consult with an avian expert regarding questions about the respiratory system of birds, where in the lung system of birds would LA be expected to deposit, the difficulty of dissecting the lung system and performing histopathological examination of birds, and some field collection specifics.

Assessing Risks to Amphibians

- Boreal Toads and Columbia Spotted Frogs have been observed within OU3.
- Population surveys have to be done during the breeding season which starts in early spring. Crews would need to be in the field in April.
- Deformity surveys will need to be performed as soon after metamorphosis as possible.

Implementation of Sampling Plans

- Comments on the draft Phase IIA Sampling and Analysis Plan should be submitted to EPA no later than Friday March 7. EPA will conduct a conference call to discuss comments on Tuesday March 11 at 9:00 AM mountain time.
- Comments on the draft Problem Formulation for Ecological Risk Assessment at Operable Unit 3 should be submitted to EPA no later than March 18. The final Problem Formulation Document will reflect the EPA ecological risk assessment

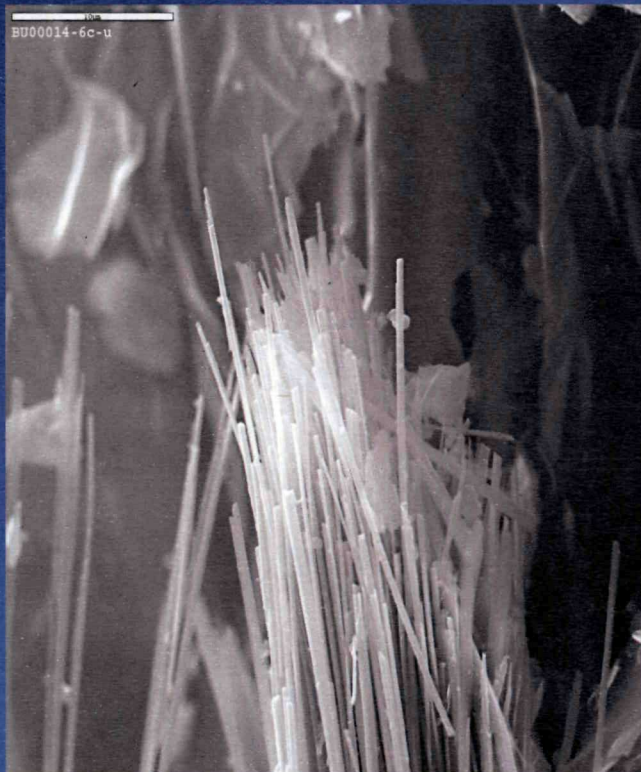
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strategy for OU3 as well the planned phasing of sampling to support ecological risk assessment.

- The development of quantitative preliminary remediation goals (PRGs) protective of ecological receptors for all media may or may not be necessary to support remedial decisions at OU3. The scope of the potentially affected area and the uncertainty associated with development of PRGs for some media will be assessed at the appropriate time.
- BTAG participants recommended focusing the scope of the ecological risk assessment and the studies to support it on what is needed to support remedial decisions at OU3.

Asbestos Profile Presentation

Asbestos Profile



SEM Image
(Libby Amphibole - Residential Dust)

Courtesy: USGS-Denver Microbeam Lab

Mineralogy

■ Two Forms

- Serpentine- possessing relatively long, thin and flexible crystalline fibers (**Chrysotile is the only type**)
- Amphibole- shorter, needle-like and substantially more brittle than serpentine (**Types include actinolite, amosite, anthophyllite, rebeckite (crocidolite), tremolite, winchite, richterite, and fluoro-edenite**).

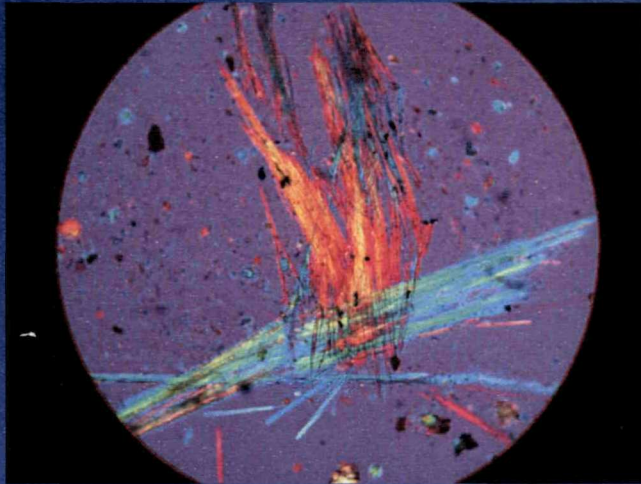
- Libby Vermiculite Deposit contains amphiboles of several compositions including winchite, richterite, tremolite, and possibly magnesioriebeckite.



SEM Image
(Libby Amphibole - Residential Dust)

The morphology of Libby amphibole (LA) ranges from prismatic crystals to asbestiform fibers, and most individual particles display features intermediate between cleavage fragments and long flexible fibers

Polarized Light Microscopy (PLM)



PLM Image of Tremolite
(blue)

- Light is transmitted through the sample and then filtered with a polarizing lens in order to visualize its components.
- Used for examining asbestos particles in soil and sediment material.
- Semi-quantitative. The limit of detection for this method is $< 1\%$ asbestos. Results are reported as area fraction or mass fraction .

Electron Microscopy



Electrons are used instead of light to visualize the specimen. Instead of glass lenses focusing the light wavelengths, electromagnetic lenses are used to focus the electrons on the sample.

Transmission Electron Microscopy (TEM)

- Asbestos morphology (2 dimensional)
- Asbestos mineral & crystalline structure
- Count Structures
- High Magnification ($\approx 500 - 20,000\times$)



Chrysotile (6,600X)

Counting Procedures

Counting rules & procedures vary with the method of analysis.



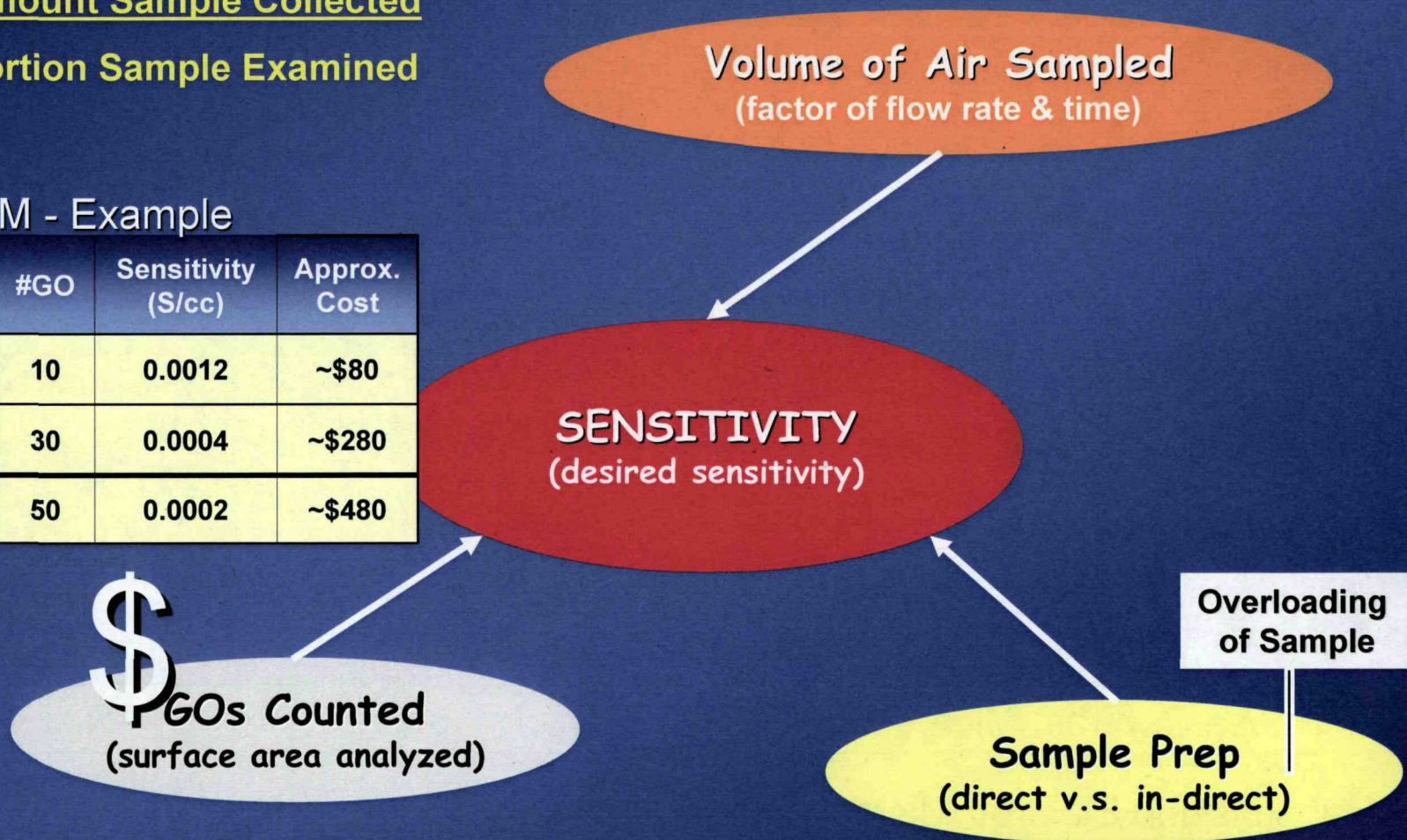
Analytical Technique	Length	Aspect Ratio
Phase Contrast Microscopy (PCM)	$L \geq 5 \text{ } \mu\text{m}$	$AR \geq 3:1$
Transmission Electron Microscopy (TEM)	$L \geq 0.5 \text{ } \mu\text{m}$	$AR \geq 3:1$ or $5:1$ (depending on method)

Sensitivity - Balancing Act

$$S(f_x) = \frac{\text{Amount Sample Collected}}{\text{Portion Sample Examined}}$$

TEM - Example

Volume of Air (Liters)	#GO	Sensitivity (S/cc)	Approx. Cost
2,500	10	0.0012	~\$80
2,500	30	0.0004	~\$280
2,500	50	0.0002	~\$480



Analytical Methods Used in Phase I

	Media	Quantification	Reporting Units
Transmission Electron Microscopy (TEM)	Surface Water	Quantitative	Millions of fibers (MF) per liter
	Air	Quantitative	Structures per ml of air
Polarized Light Microscopy (PLM)	Soil and Sediment	Semi-quantitative	Fraction (%)

Releases to the Environment



- Asbestos at Libby was released as a result of mining activities
- Asbestos was detected in surface water, sediments, and forest soils
- Asbestos may be released as a result of the weathering of natural deposits of asbestos-bearing rocks.



Transport and Deposition

- Once released asbestos fibers settle out of the air or water and deposit in soil or sediment.
- Fibers can be re-suspended into the air or water following disturbances.
- In water, fibers may be transported with water flow.
- In soils, fibers tend to be retained at or near the surface. Particles in soils are fairly immobile.



Transformation and Degradation



- Asbestos fibers are nonvolatile and insoluble and persist under typical environmental conditions.
- Asbestos fibers are resistant to thermal degradation and chemical attack. Chrysotile may degrade more readily than amphibole asbestos.
- In water at low pH, chrysotile fibers may undergo some dissolution but not amphibole.
- In soils, asbestos fibers are not known to undergo transformation or degradation. There are some reports that chrysotile asbestos may degrade in soil altering soil pH releasing trace metals to the environment.

Bioaccumulation

- Fish
- Invertebrates
- Laboratory Mammals
- Field Mammals

Possible Ecological Exposures

- Soils
 - Inhalation - Related to disturbances
 - Ingestion (direct and food items)
- Surface Water
 - Direct Contact
 - Ingestion (food items)
- Sediment
 - Direct Contact
 - Ingestion (food items)
- Foliar Surfaces/Trees
 - Inhalation – Related to disturbances

Summary of Toxicity Data

	Exposure Route	Asbestos Type	Effect (Endpoint)
Aquatic Invertebrates	Water	Primarily Chrysotile	MOR, BEH, GRO, REP, PATH, ACC
Fish	Water	Chrysotile	MOR, BEH, GRO, REP, PATH, ACC
Aquatic Plants	Water	Chrysotile	ACC
Terrestrial Plants	--		
Soil Invertebrates	--		
Birds	--		
Mammals	Diet, Gavage, Inhalation	Chrysotile, amosite, mixtures	MOR, BEH, GRO, REP, PATH, ACC

Pathology Effects - Fish

- Asbestos exposures in fish are known to be associated with certain pathology effects.
- Most studies are with chrysotile asbestos.
- Effects have been noted for the lateral line, epidermis, gill, kidney, muscle, and heart.
- Distortion, erosion, swelling and distention of the lateral line was associated with adverse rheotactic behavior.
- Typical lesions include degeneration, necrosis, hyperplasia, and erosion.

Pathology Effects - Mammals

- Asbestos exposures in mammals are known to be associated with certain pathology effects.
- A large number of studies have been performed in mammals to identify the effects of asbestos on the respiratory tract, and to a lesser degree on other organs (e.g. gastrointestinal tract).
- Ingestion exposures have been associated with lesions in the parathyroid tissue, brain tissue, pituitary tissue, endothelial tissue, kidney tissue, and peritoneum tissue (Cunningham et al., 1977). Induction of aberrant crypt foci in the colon (Corpet et al., 1983) and tumors of the gastrointestinal tract have also been reported.
- Inhalation exposures are associated with fibrosis, lung tumors and lesions along the respiratory bronchioles, alveolar ducts, alveoli, and lung tissue (McGavran et al. 1989; Donaldson et al. 1988; Davis et al., 1980a, 1980b, 1985, 1986). Mesotheliomas have been observed (Davis and Jones 1988, Davis et al. 1985, Wagner et al. 1974, 1980, Webster et al. 1993).

Limitations of Data

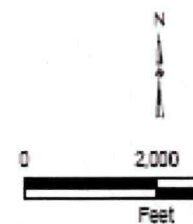
- Only one study with birds
- No studies with terrestrial plants or soil invertebrates
- No studies with Libby amphibole
- Most studies are for chrysotile
- Mammalian toxicity studies are focused on carcinogenesis as the endpoint.

Presentation of Phase I Sampling Results



Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream
- Surface Water/Sediment

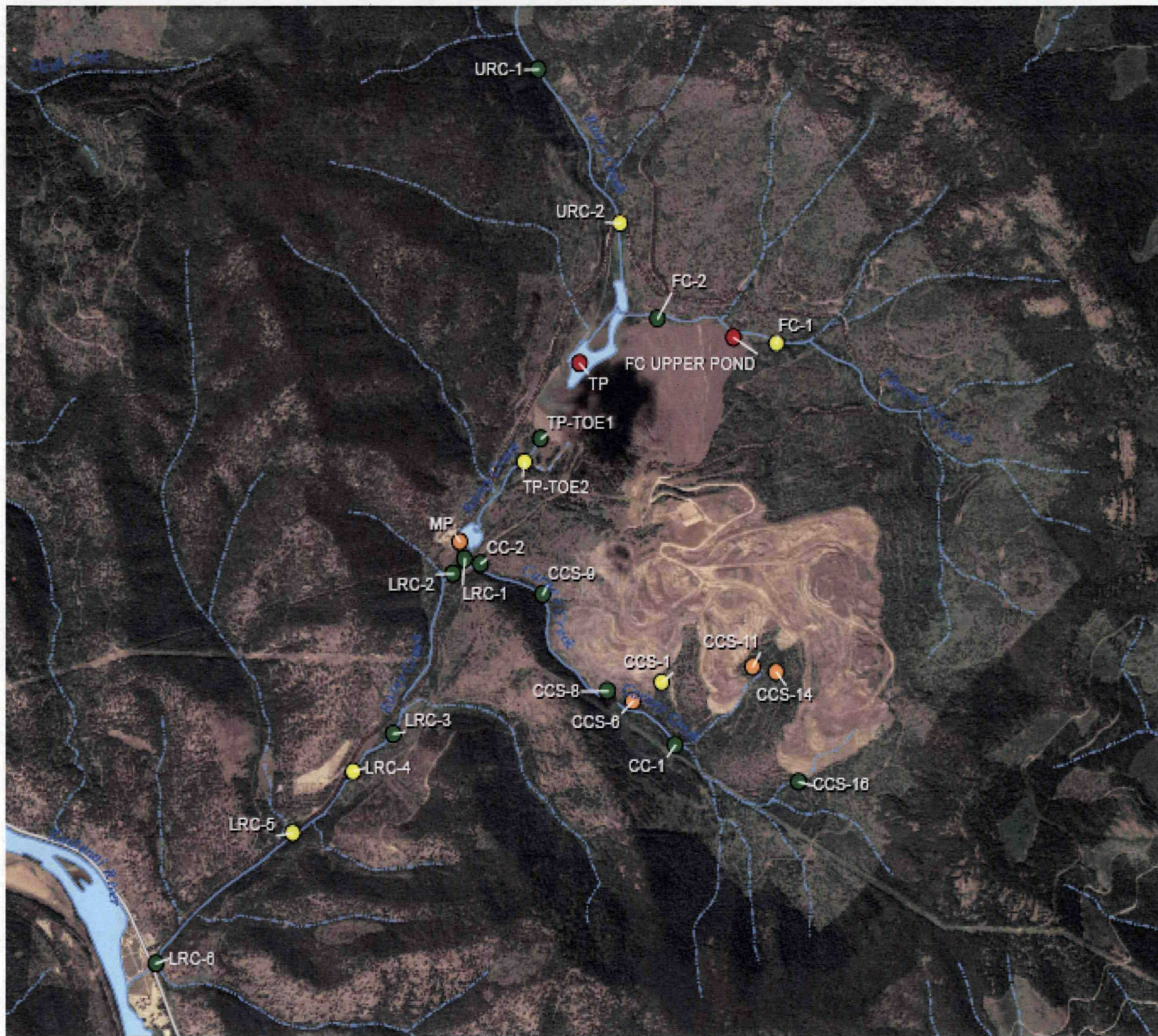


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FIGURE 2:
PHASE I SURFACE W/
SEDIMENT SAMPLE L

PROJECT: 0100-008-003 DATE: J
REV: 0 BY: CRL

NEWFIELD

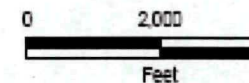


Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream

Asbestos in Surface Water (T)

- ND - 1 MFL
- 1 - 10 MFL
- 10 - 100 MFL
- > 100 MFL



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FIGURE 2-10
ASBESTOS LEVELS
SURFACE WATER

PROJECT: 0100-008-001 DATE: FEB. 3, 2001
REV: 0 BY: CRL CH

NEWFIELDS



Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream

Asbestos Levels in Sediment (

- ND
- B1 (TR)
- B2 (<1%)
- C (2 - 6%)

DRAFT



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OPERABLE UNIT 3

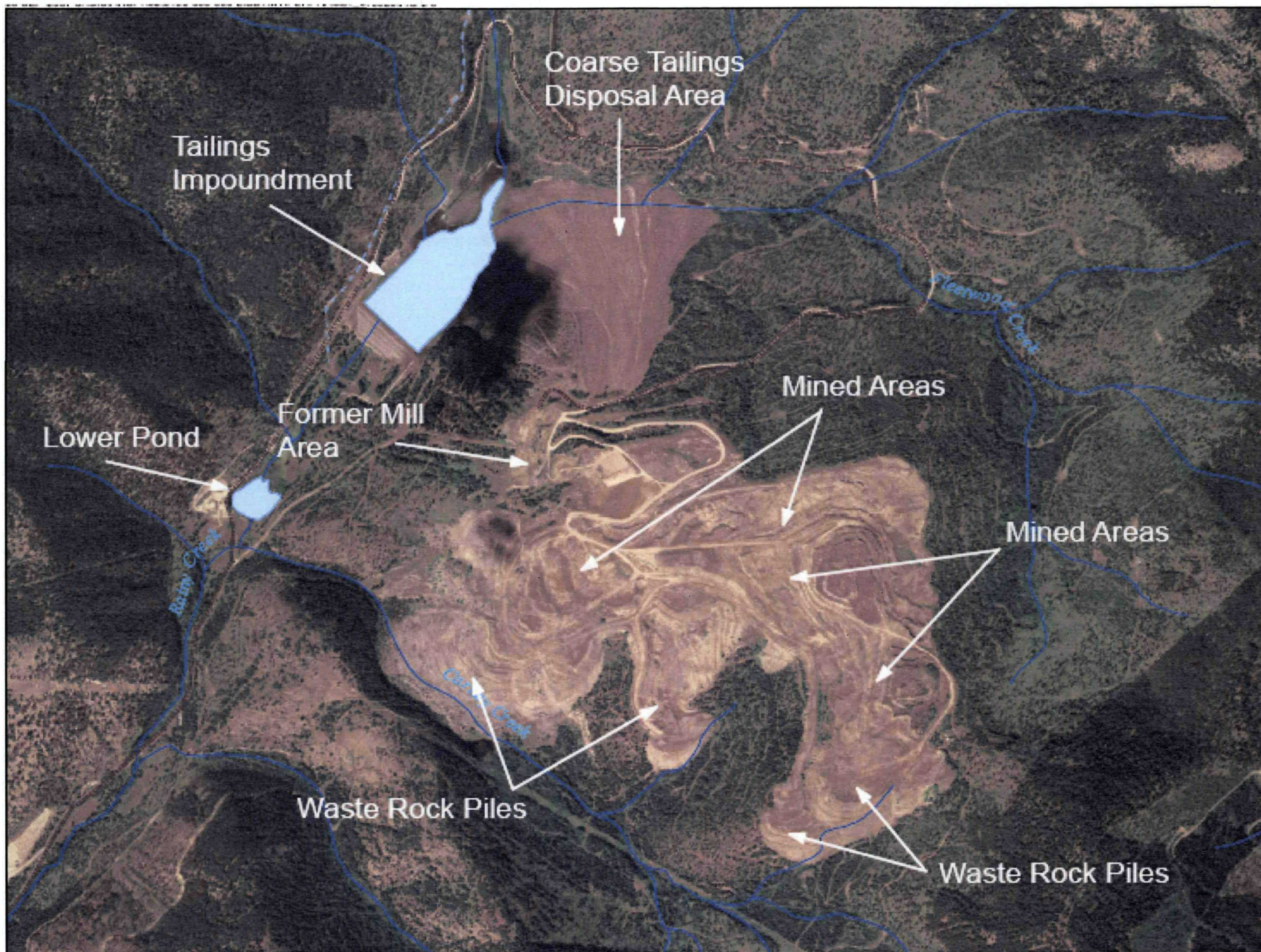
FIGURE 2-11
ASBESTOS LEVELS
IN SEDIMENT
Data not yet validated

PROJECT 9100-208-900 DATE FEB. 1, 2008
REV: 0 BY: CRL CH

NEWFIELDS

Phase I Findings

- Highest levels of LA in SW were located in ponds or impoundments
- NO LA was detected in URC-1, TP-Toe1, LRC-6, 3 seeps along Carney Creek
- LA detected in 22 out of 24 sediment locations
- At some locations, there is LA in sediment but not SW



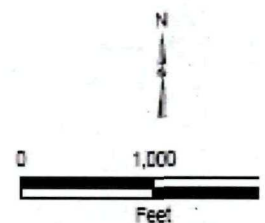


Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream
- Mined Area

MineWaste Sampling L

- Waste Rock
- Cover Material
- Outcrop
- Coarse Tailings
- Tailings Impoundment
- Road



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OPERABLE UNIT 3

FIGURE 5-1

MINE WASTE
SAMPLING LOCATION

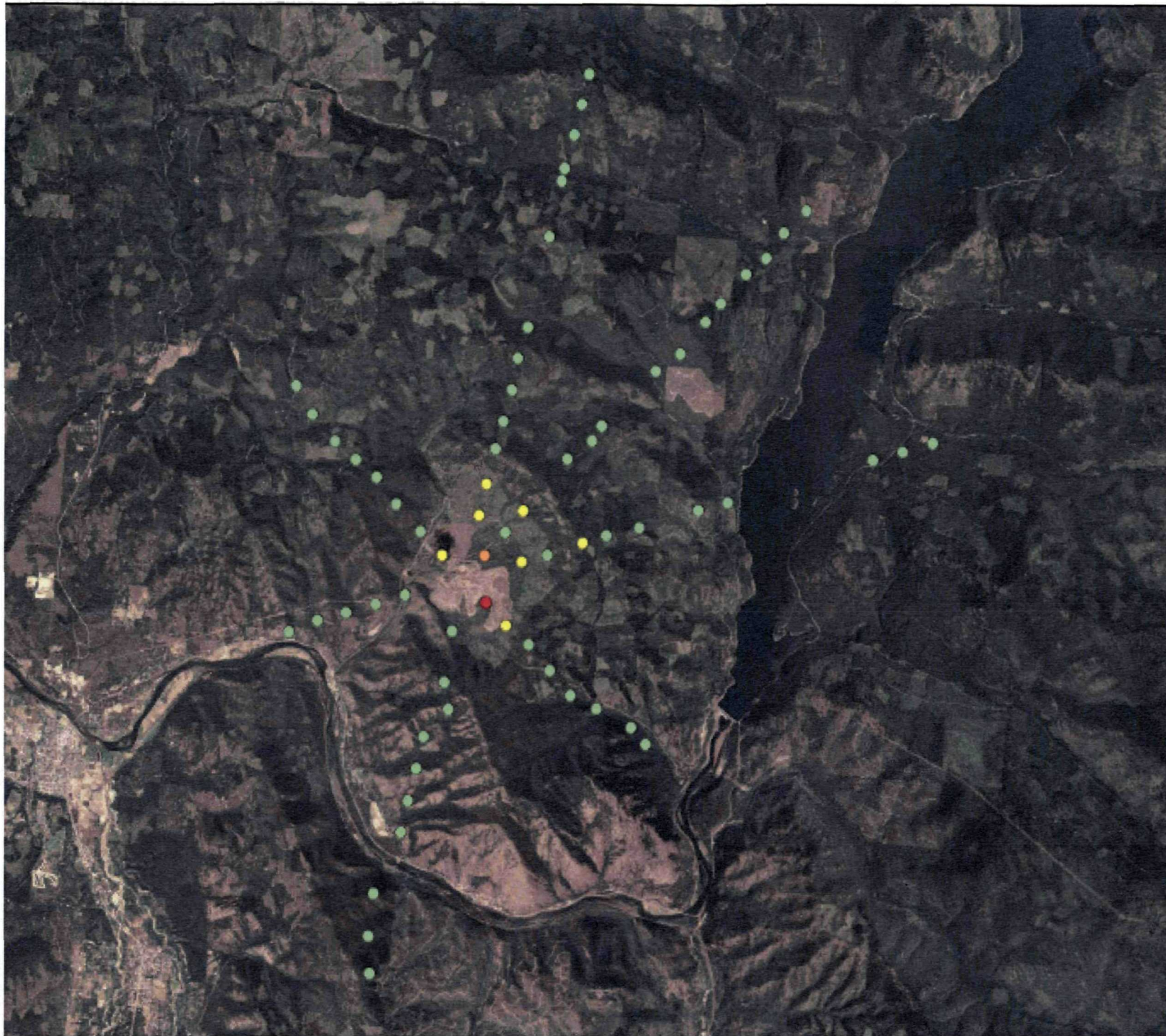
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NEWFIELD

Phase I Findings

- **LA in fine tailings:** <1% in fine fraction, trace in coarse fraction
- **LA in coarse tailings:** up to 2% in fine fraction, trace – 1% in coarse fraction
- **LA in cover material:** over 2% in one sample
- **LA in waste rock and out crop:** range from trace to 8%





Legend

Asbestos Levels in Soil (f

- ND
- B1 (TR)
- B2 (<1%)
- C (2 - 6%)

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FIGURE 2-14

**ASBESTOS LEVELS
FOREST SOILS**

Data not yet validated

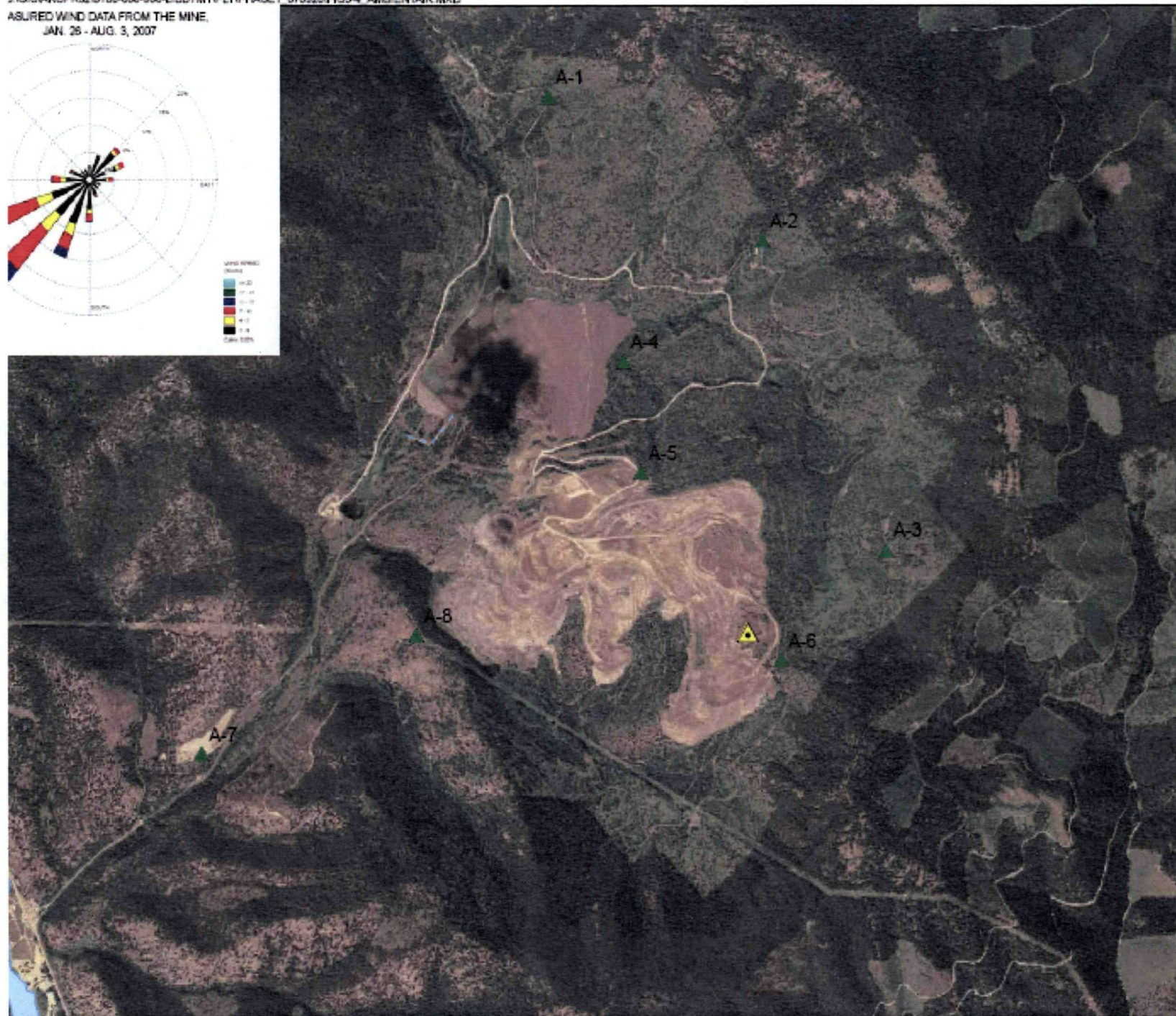
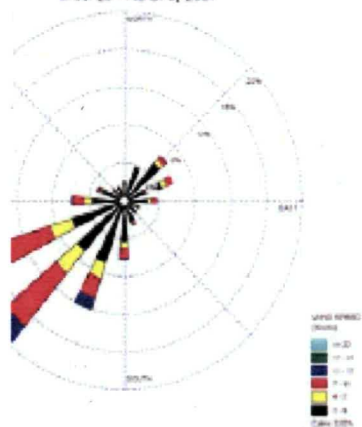
PROJECT: 0100-008-900 DATE: FEB 11
REV: 0 BY: CRL CF

NEWFIELDS

Phase I Findings

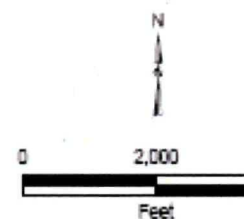
- LA was detected in forest soil samples close to mined area
- LA was not detected in forest soil samples at a distance more than 1.5 miles from the mined area

ASURED WIND DATA FROM THE MINE,
JAN. 25 - AUG. 3, 2007



Legend

- Air Monitoring Lo
- Meteorological Sta
- Open Water
- Perennial Stream
- Intermittent Stre



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OPERABLE UNIT 3

FIGURE 2-15

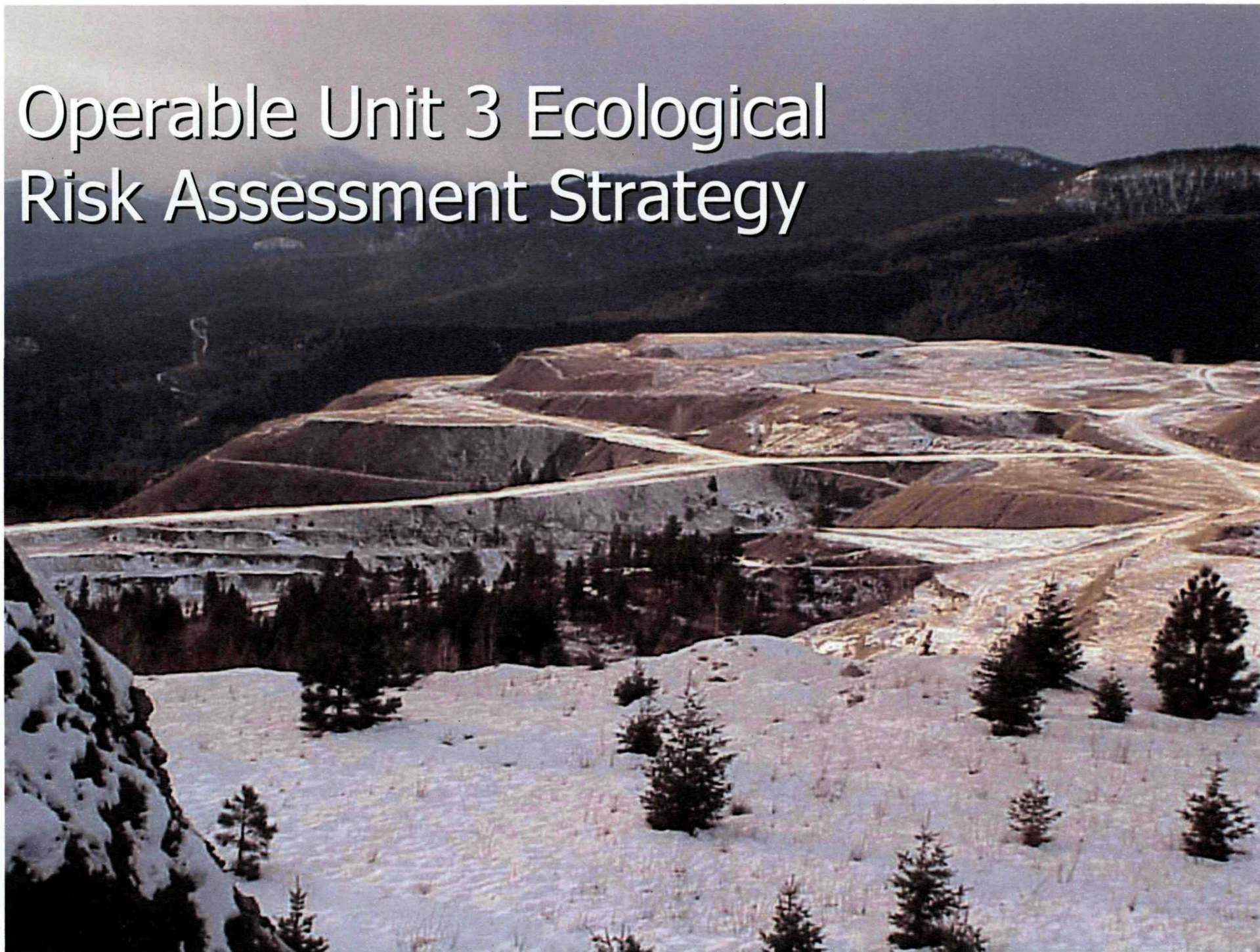
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PROJECT: 0100-008-900 DATE: SEP 28
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NEWFIELD

Presentation of
Ecological Risk Assessment
Strategy

Operable Unit 3 Ecological Risk Assessment Strategy



Overview

- Typical Approaches
- Challenges Unique to OU3
- Receptor Specific Strategies

Lines of Evidence

- HQ Approach-Comparison to Benchmarks
- Site Specific Toxicity Testing
- Physical or Biochemical Changes
- Community Surveys

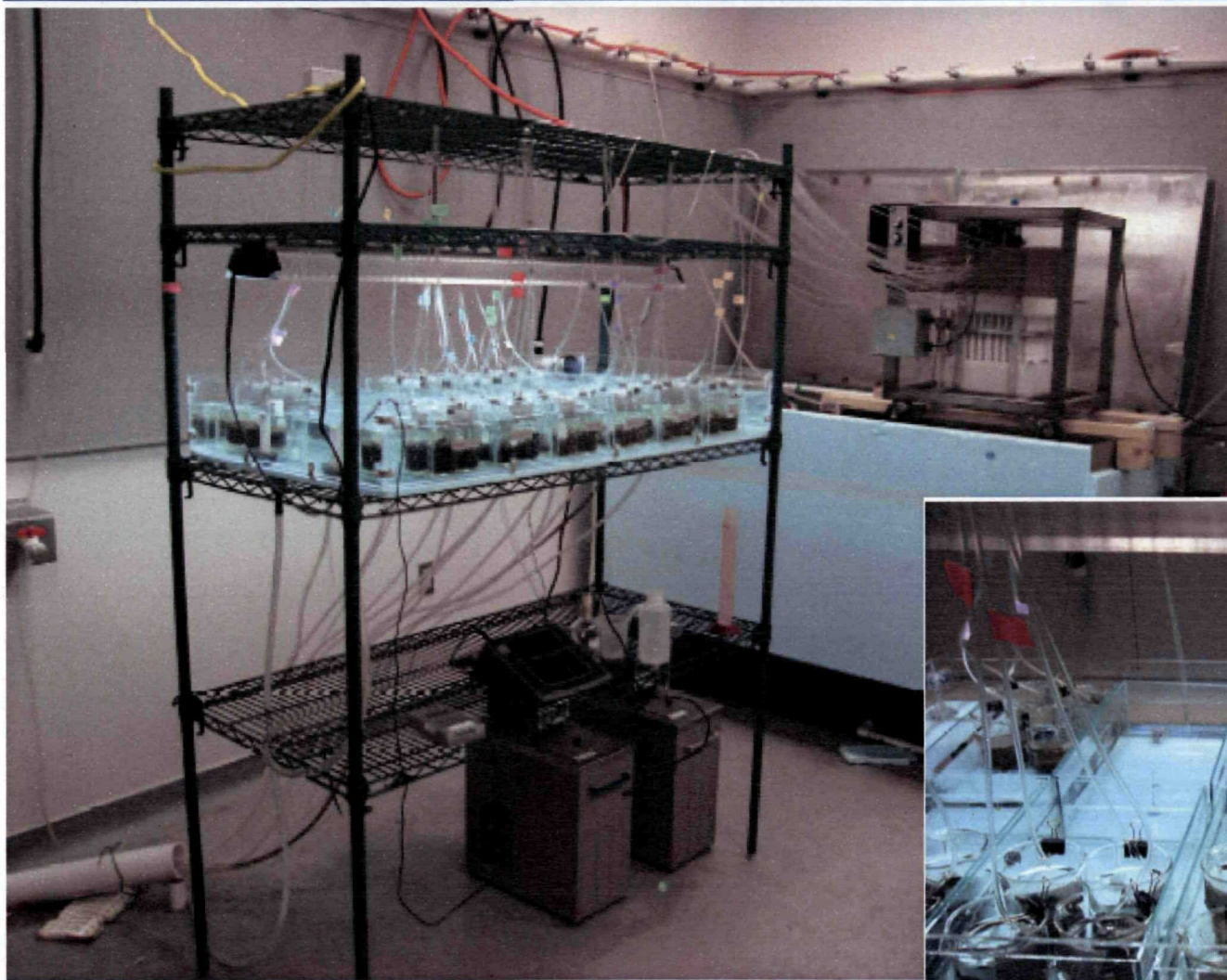
Hazard Quotient

$$\text{HQ} = \text{Exposure} / \text{Benchmark}$$

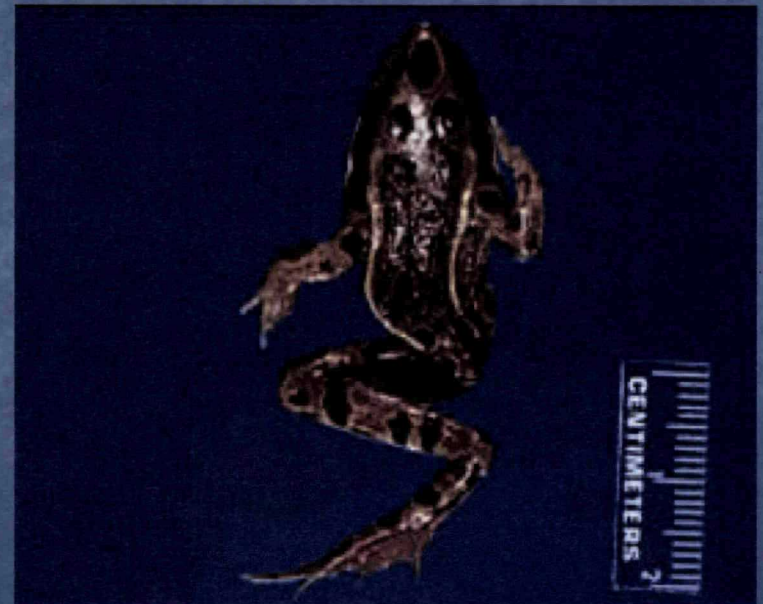
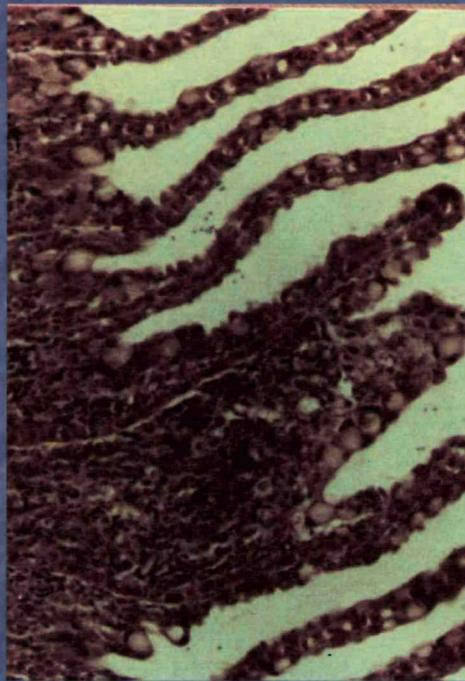
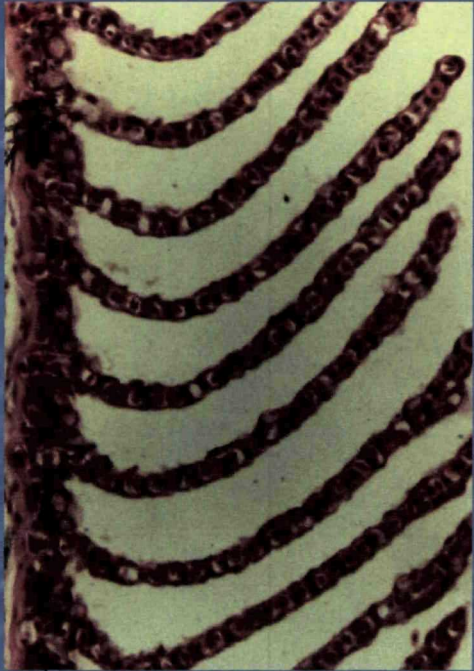
$\text{HQ} < 1$ = Acceptable risk

$\text{HQ} > 1$ = Further evaluation warranted

Tox Testing



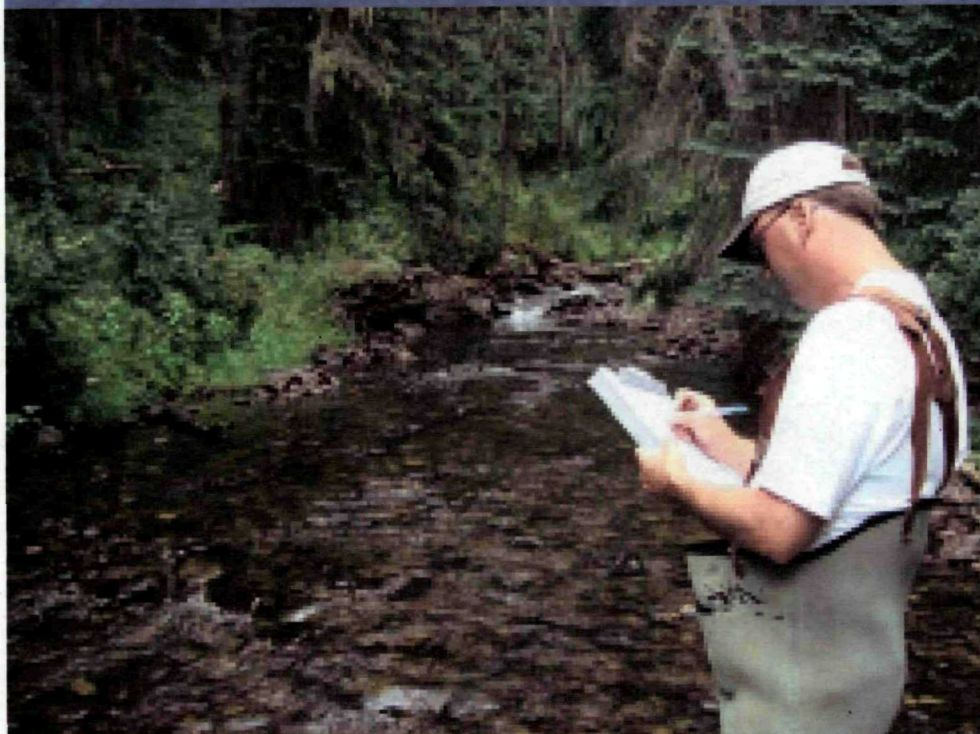
Physical or Biochemical Changes



Community Surveys



Community Surveys-Habitat



HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

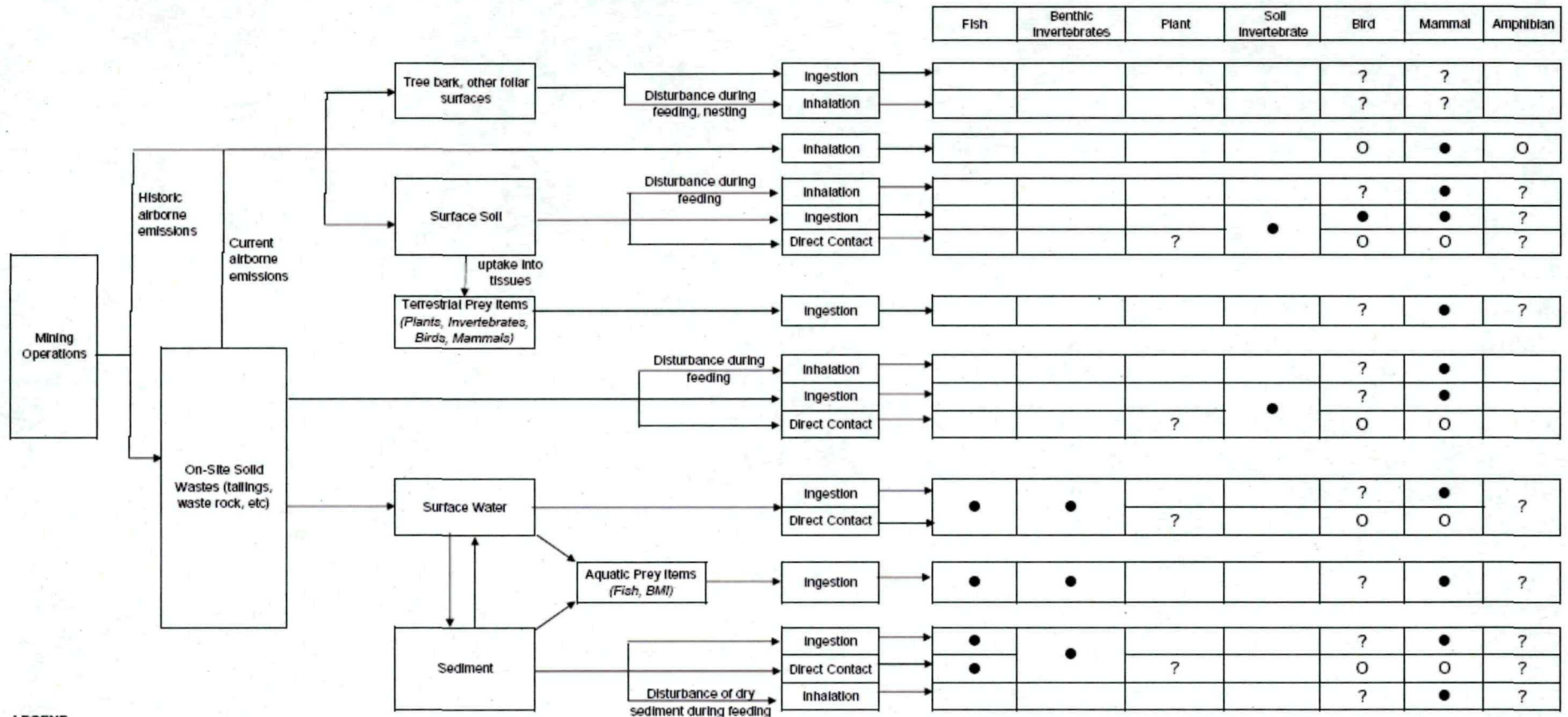
Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks, and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends) Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB) SCORE 4 (RB)	Left Bank 10 9 8 7 6 Right Bank 10 9 8 7 6	5 4 3 2 1 0 5 4 3 2 1 0	5 4 3 2 1 0 5 4 3 2 1 0	2 1 0 2 1 0
9. Vegetative Protection (score each bank) More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE 12 (LB) SCORE 11 (RB)	Left Bank 10 9 8 7 6 Right Bank 10 9 8 7 6	5 4 3 2 1 0 5 4 3 2 1 0	5 4 3 2 1 0 5 4 3 2 1 0	2 1 0 2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone) Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.	
SCORE 7 (LB) SCORE 9 (RB)	Left Bank 10 9 8 7 6 Right Bank 10 9 8 7 6	5 4 3 2 1 0 5 4 3 2 1 0	5 4 3 2 1 0 5 4 3 2 1 0	2 1 0 2 1 0

Total Score 107

OU3 ERA Challenges

- Analytical sensitivity low for solid media
- No benchmarks or toxicity reference values
- Reference condition or exposure gradient
- Unique routes of exposure
- No ERA precedent for asbestos
- Relevance of expected effects to population

Figure 3-2. Conceptual Site Model for Exposure of Ecological Receptors to Asbestos at OU3



LEGEND

- Pathway is believed to be complete, and which may provide an important contribution to the total risk to the receptor.
- Pathway is believed to be complete but is unlikely to be a major contributor to the total risk to the receptor (in comparison to one or more other pathways).
- Pathway is incomplete or believed to be negligible
- ? Pathway that is or might be complete, but current data are not adequate to decide if it is a significant contributor to the total risk of the receptor.

AQUATIC

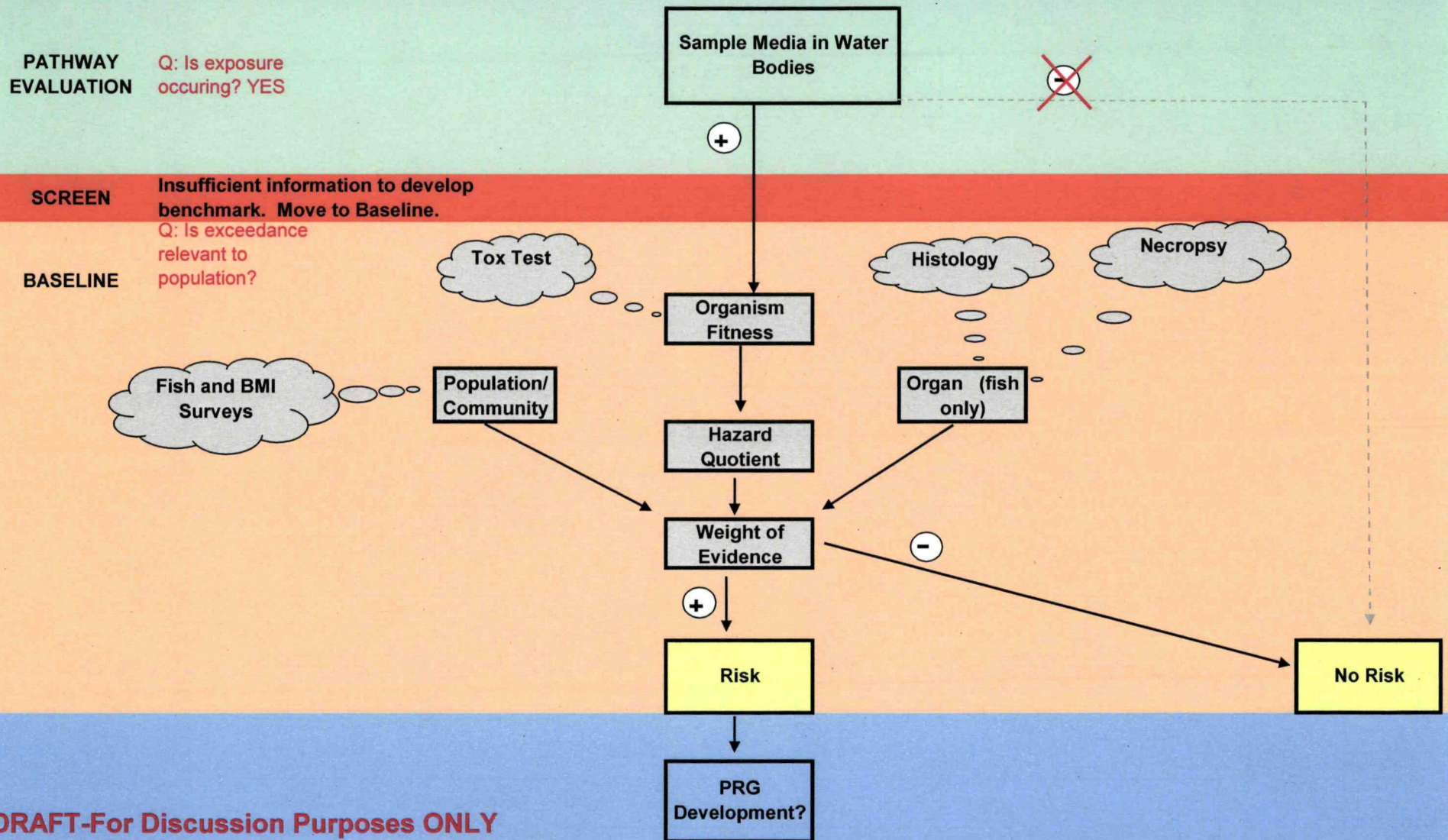
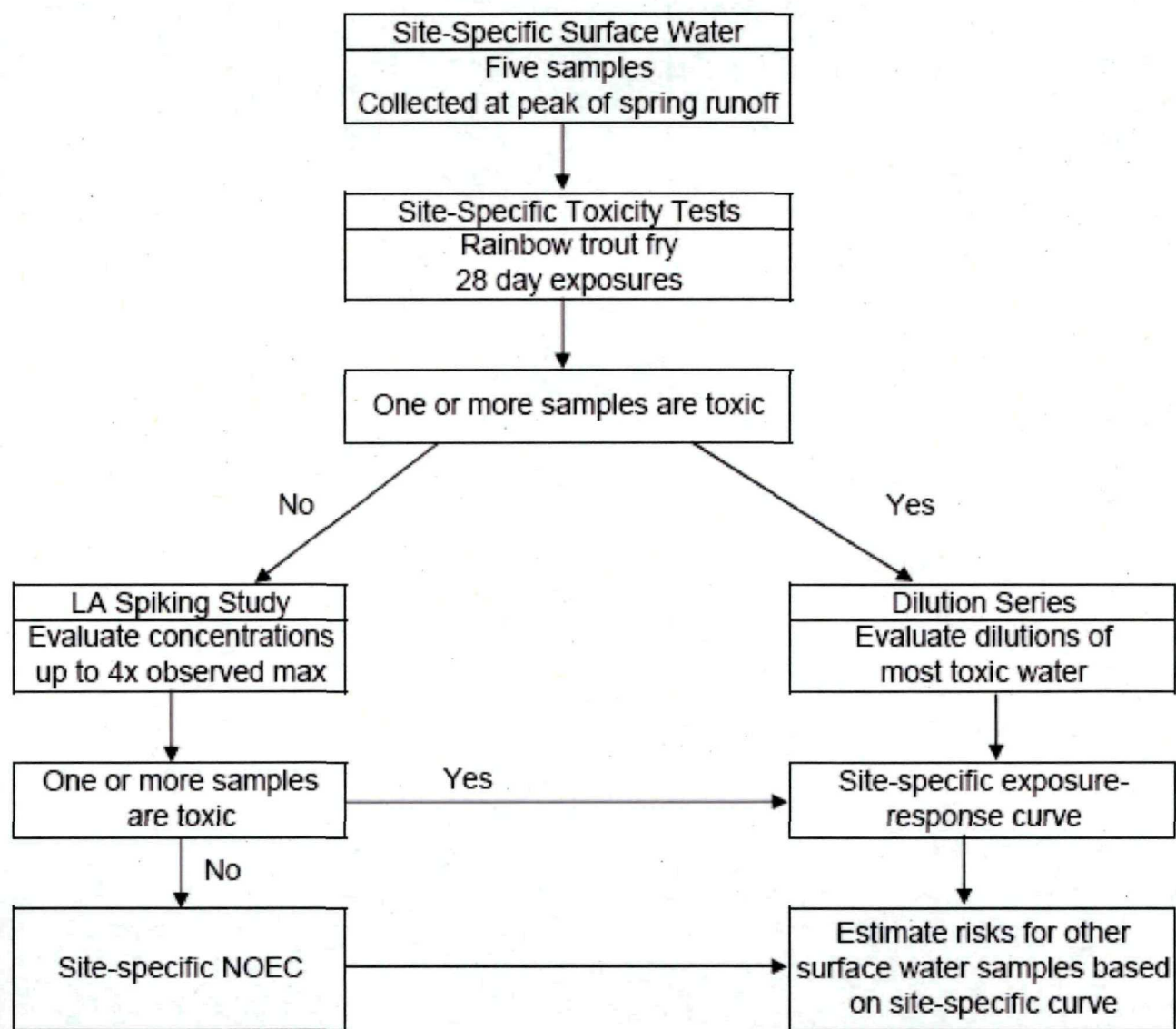


FIGURE 6-1
STRATEGY FOR SITE-SPECIFIC TESTING OF
RISKS TO AQUATIC ORGANISMS FROM ASBESTOS IN SURFACE WATER



MAMMAL

PATHWAY EVALUATION

Q: Is exposure occurring?

Sample Tissue(s) Along Contamination Gradient

-

SCREEN

Insufficient information to develop benchmark. Move to Baseline.

BASELINE

Q: Is exposure relevant to population?

Collect demographics

Population/Community

and

Organ

Histology

Necropsy

Either it's agreed that data indicates risk or further evaluation is needed.

Wait on LAP

Respiratory Function?

Secondary Stressors?

Predator Avoidance?

Organism Fitness

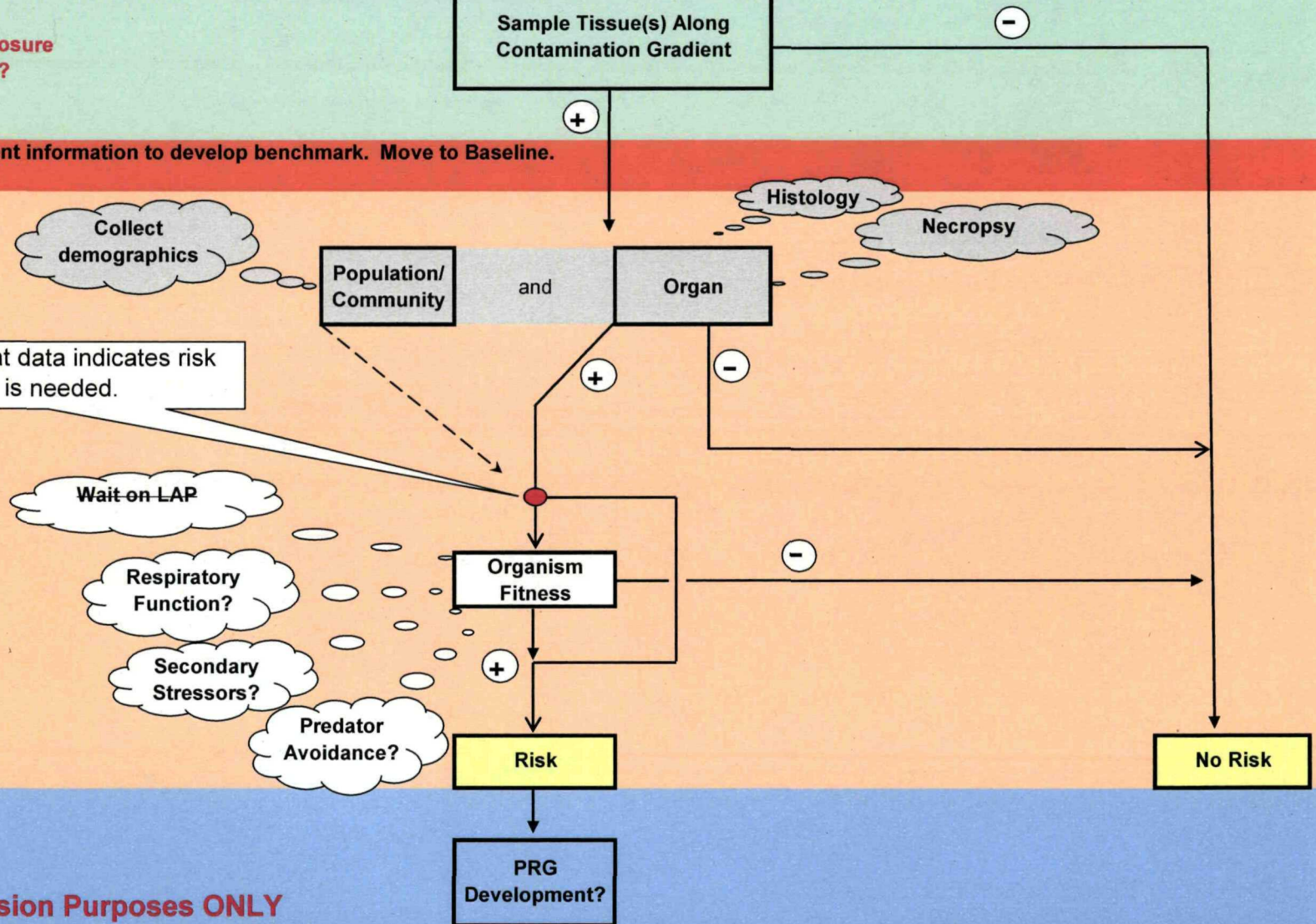
+

Risk

PRG Development?

No Risk

DRAFT-For Discussion Purposes ONLY



AVIAN

PATHWAY
EVALUATION

Q: Is exposure
occurring?

SCREEN

Insufficient information to develop benchmark. Move to Baseline.

BASELINE

Q: Is exposure
relevant to
population?

At present, community surveys not believed
to be reliable measurement endpoint.

Either it's agreed that data indicates risk
or further evaluation is needed.

Sample Tissue(s) Along
Contamination Gradient

+

Organ

+

Organism
Fitness

+

Risk

PRG
Development?

-

Histology

Necropsy

Field Studies?

-

Dosing
Study?

-

Metabolic or
Respiratory
Fitness?

Secondary
Stressor?

No Risk

DRAFT-For Discussion Purposes ONLY

PLANTS

PATHWAY EVALUATION

Q: Is exposure
occurring?

Sample Soils
(off site)

SCREEN BASELINE

Insufficient information to develop
benchmark. Move to Baseline.

Q: Is exceedance
relevant to
population?

Limited in scope.
Target hot spot(s).

Population/
Community

and

Organism
Fitness

Tox Tests

Weight of
Evidence

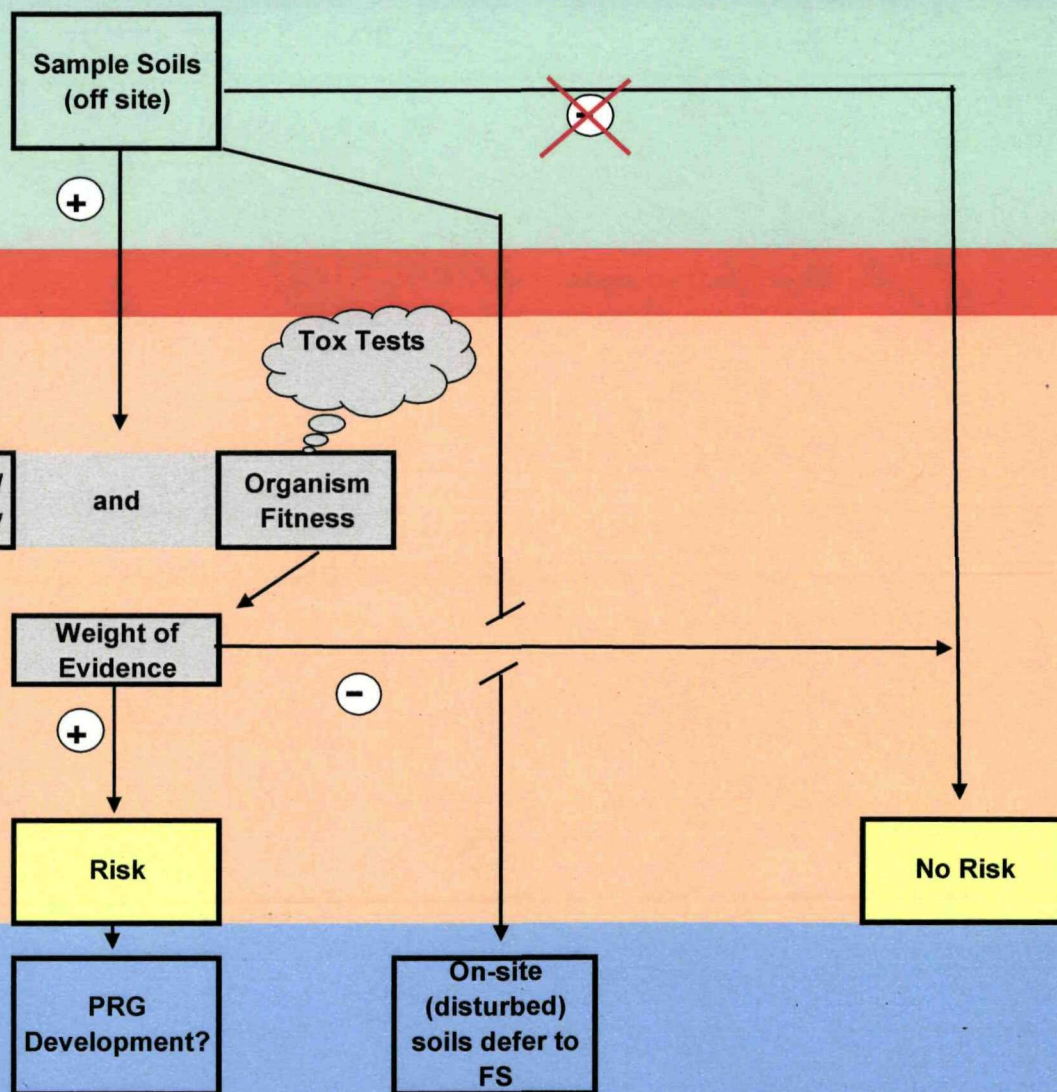
Risk

PRG
Development?

No Risk

On-site
(disturbed)
soils defer to
FS

DRAFT-For Discussion Purposes ONLY



TERRESTRIAL INVERT

**PATHWAY
EVALUATION**

Q: Is exposure
occurring?

**SCREEN
BASELINE**

Insufficient information to develop
benchmark. Move to Baseline.

Q: Is exceedance
relevant to
population?

Limited in scope.
Target hot spot(s).

Sample Soils
(off site)

+

Organism
Fitness

Tox
Tests

-

+

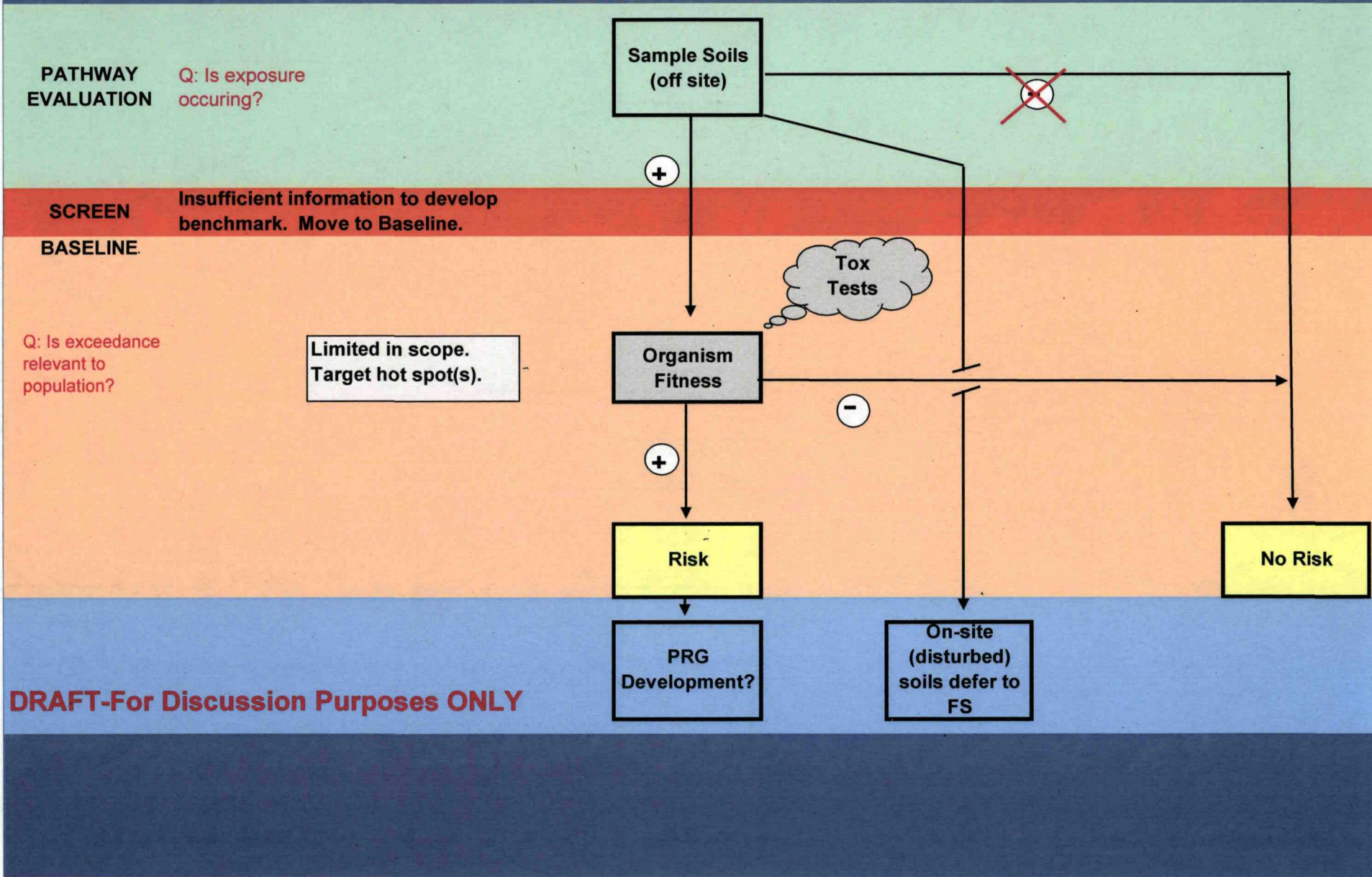
Risk

PRG
Development?

On-site
(disturbed)
soils defer to
FS

No Risk

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AMPHIBIAN

PATHWAY EVALUATION

Q: Is exposure
occurring? YES

Sample Soil/Sed/Water

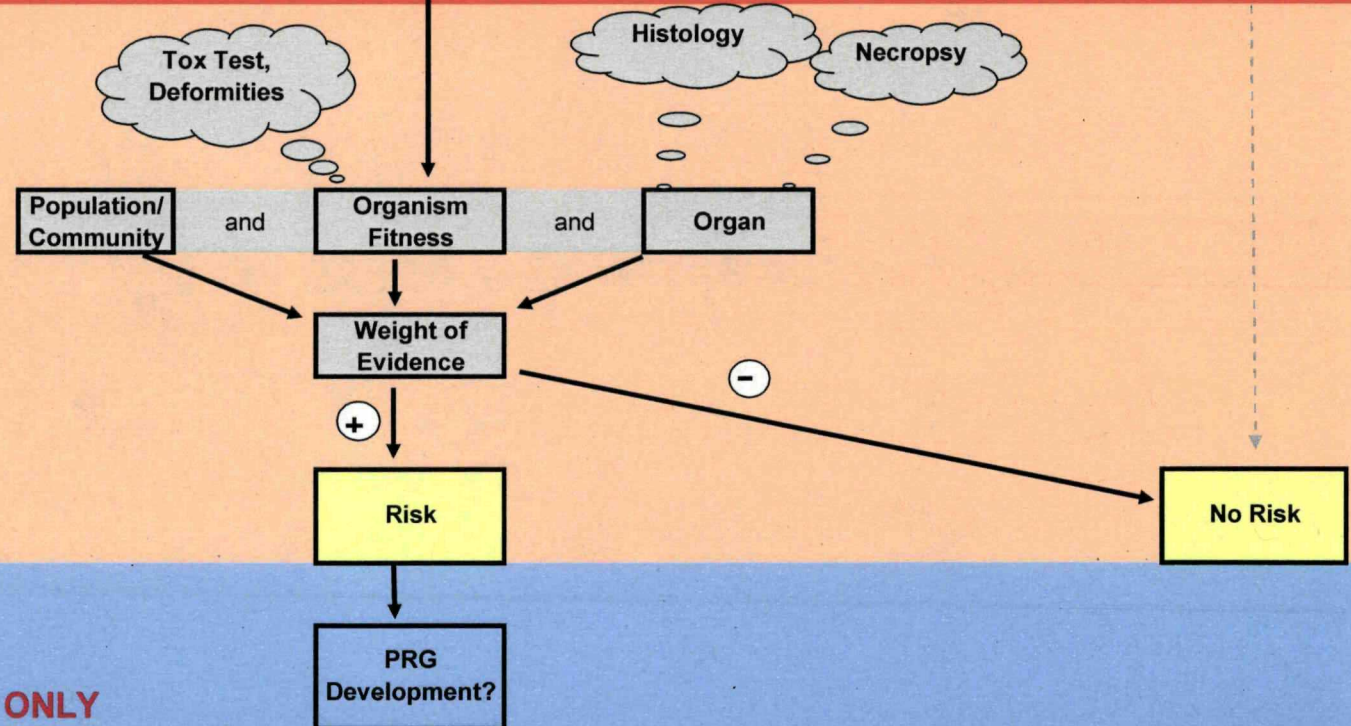


SCREEN

Insufficient information to develop
benchmark. Move to Baseline.

BASELINE

Q: Is exceedance
relevant to
population?



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